KC 16124

ELASTIC LAMINATE WITH DIRECTIONAL BONDING AND METHOD OF MANUFACTURE

Field of Invention

The present invention relates to elastic laminates, manufacturing methods for making such elastic laminates, and disposable product applications of such elastic laminates. Particularly, the invention relates to the use of bond lines in conjunction with such elastic laminates to control such properties as stretchability and retraction.

Background of Invention

Many types of elastic webs and laminates along with their methods of manufacture are well known in the art. These materials have been used in many personal care products as their stretchable nature provides useful properties to the product such as comfort and fit, among many other properties.

Some of these elastic webs can stretch in more than one direction while others stretch primarily in a single direction. Types of well known elastic materials include materials having at least one elastic sheet and at least one material which is necked (i.e., stretched in the machine direction and allowed to contract in width) and then is joined to the elastic sheet. Another well known elastic material uses stretched elastic filaments which are joined to at least one layer of an extensible or gatherable material. The processes for making such elastic materials, whether it contains an elastic sheet or elastic filaments, are also well known.

The stretchability of such elastic materials is in part dependent on the elastic materials being used as well as the method by which the laminated materials are put together. In the case of elastic materials with elastic filaments, the amount the elastic filaments are stretched before being joined to another material will affect the level of the stretch available in the finished elastic material.

The stretchability of such elastic material is also affected by the material that is attached to the elastic component of the elastic material. Such relatively non-elastic materials are necessary to provide support and structure to the elastic component, but also act to provide a limit to the amount of stretch ultimately available in the finished elastic laminate. In the case of elastic laminates made with elastic sheets and necked materials, the amount of necking in the necked material will in part determine the ultimate stretch of the laminate in the direction of the necking.

Additionally, it is also known that the method and degree of bonding used to attach the elastic component to the relatively non-elastic component will also act as a limitation to the stretch of the ultimate elastic laminate. A high degree of bonding can prevent delamination, but can also tie up the elastic component of the laminate and limit, if not completely eliminate, the stretch of the laminate. It is also known that selective bonding such a laminate can be used to control the stretch properties of the laminate. Bonding can be used to limit the stretch in certain areas of an elastic laminate while allowing stretch in other areas.

Related to the stretch property of such elastic laminates is the property of retraction. Some such elastic laminates have an inherent latency imparted to the material through their manufacturing process. Such materials, when exposed to an elevated temperature, will shrink or retract. In some applications, this property is undesirable as such shrinkage within a converting process can cause production problems. In other applications, such a property is useful to provide a desired "gathering" function.

It is desirable when designing and making new stretchable products to have a material that maximizes the amount of stretch available or conversely minimizes the amount of stretch available. It would also be useful if one could control the ultimate amount of stretch and/or retraction in various portions of a single elastic laminate. Finally, it would also be desirable to have a material that maximizes the amount that it is capable of retracting upon activation and conversely another material that minimizes the amount of activated retraction.

Summary of the Invention

The present invention is directed to a composite elastic material, with a first and a second direction, the second direction being perpendicular to the first. The composite elastic material is made of a flexible nonwoven layer, a layer of substantially parallel elastomeric filaments, and a bonding component which joins the elastomeric filaments to the nonwoven layer. The bonding component may be an adhesive. Alternatively, the bonding component may be a layer of elastomeric meltblown fibers. To control the stretch and/or retraction of the composite elastic material, the nonwoven layer has a plurality of bonding elements that result in bond pattern with greater bonding aligned in the first direction than the bonding aligned in the second direction. The bond elements have a first bond dimension relative to the first direction and second bond dimension relative to the second direction, where the first bond dimension is greater than the second bond direction. A ratio of the sum of the first bond dimensions over the sum of the second bond dimensions, for a unit area of the bond pattern, has a value greater than one and thus indicates that the bond pattern has more bonding in the first direction than in the second direction.

In one embodiment the elastomeric filaments of the composite elastic material are parallel to the first direction. Alternatively, the elastomeric filaments may be parallel to the second direction.

In another embodiment of the present invention, the composite elastic material has a second flexible nonwoven layer which is also joined to the elastomeric filaments. This second nonwoven layer also has a plurality of bonding elements that result in greater bonding aligned in first direction than the bonding directed in a second direction.

To further control the stretch and/or retraction of the composite elastic material, another embodiment of the present invention includes the use of a plurality of laminate bonding elements on the composite elastic material. These laminate bonding elements have a greater bonding in the first direction than they have in the second direction. Alternatively, the laminate bonding elements may have a greater bonding in the second

direction than they have in the first direction. These laminate bonding elements can be either thermal bonds or ultrasonic bonds.

The invention provides a method for forming a composite elastic material having a first direction and a second direction, the second direction being perpendicular to the first direction. The method includes the steps of:

a) providing at least one flexible nonwoven layer having a plurality of bonding elements such that there is greater bonding in a first direction than bonding in a second direction, where the second direction is nonparallel to the first direction;

b) providing a layer of substantially parallel elastomeric filaments adjacent to a surface of the nonwoven layer;

c) providing a bonding component; and

d) joining the nonwoven layer to the layer of elastomeric filaments in a face to face configuration.

The provided bonding component may be an adhesive that is applied to the surface of the nonwoven layer.

Alternatively, the provided bonding component may be a layer of elastomeric meltblown fibers applied to the layer of elastomeric filaments.

In one embodiment, the method also includes providing a second flexible nonwoven layer, where the second nonwoven layer has a plurality of bonding elements oriented in a direction selected from the first direction and a second direction nonparallel to the first direction. This second nonwoven layer is joined to the elastomeric filaments in a face to face configuration using a nip formed between an anvil calender roller and a bonding calender roller. In one embodiment this bonding calender roller is a point un-bonded calender roller. In an alternative embodiment the bonding calender roller is a smooth calender roller.

In another embodiment, the method additionally includes the step of bonding the composite elastic material with a plurality of laminate bonding elements. These laminate bonding elements have a greater bonding in the first direction than bonding in the second direction. Alternatively, the laminate bonding elements can have a greater bonding in the second direction than bonding in the first direction. The laminate bonding elements can be thermal bonds or ultrasonic bonds.

Brief Description of the Drawings

Fig. 1 is a drawing of an exemplary nonwoven bond pattern of the present invention with the bond pattern oriented in the direction shown as **X**.

Fig. 1A is a representation of a single bond element of the nonwoven bond pattern shown in Fig. 1.

Fig. 1B is a representation of the first and second bond dimensions for the bond element shown in Fig. 1A.

Fig. 2 is a drawing of another exemplary nonwoven bond pattern of the present invention with the bond pattern oriented in the direction shown as **X**.

Fig. 2A is a representation of a portion of a bond element that makes up the nonwoven bond pattern of Fig. 2.

Fig. 2B is a representation of the components that make up the first and second bond dimensions for the portion of the bond element shown in Fig. 2A.

Fig. 2C is a representation of the first and second bond dimensions for the portion of the bond element shown in Fig. 2A.

Fig. 3 is a drawing of a zoned nonwoven bond pattern of the present invention.

Fig. 4 is a view of the surface of the composite elastic material of the present invention having nonwoven facing bonds with the bond pattern oriented in the direction shown as **X** and with laminate bonding elements on the composite elastic material with the laminate bond pattern oriented in the direction shown as **Y**.

Fig. 5 is a schematic drawing of the process used to produce composite elastic materials.

Fig. 6 is a drawing of a bonding pattern known in the art as a wire weave pattern.

Detailed Description

Definitions

As used herein and in the claims, the term "comprising" is inclusive or open-ended and does not exclude additional unrecited elements, compositional components, or method steps.

As used herein, the term "personal care product" means generally absorbent products for use to absorb and/or dispose of bodily fluids, including but not limited to diapers, training pants, swimwear, absorbent underpants, adult incontinence products, and feminine hygiene products, such as feminine care pads, napkins and pantiliners. It also includes absorbent products for veterinary, medical and mortuary applications.

As used herein, the term "machine direction" or MD means the length of a web in the direction in which it is produced. The term "cross machine direction" or CD means the width of fabric, i.e. a direction generally perpendicular to the MD.

As used herein the term "nonwoven fabric or web" means a web having a structure of individual fibers or threads which are interlaid, but not in an identifiable manner as in a knitted fabric. Nonwoven fabrics or webs have been formed from many processes such as for example, meltblowing processes, spunbonding processes, and bonded carded web processes. The basis weight of nonwoven fabrics is usually expressed in ounces of material per square yard (osy) or grams per square meter (g/m^2 or gsm) and the fiber diameters useful are usually expressed in microns. (Note that to convert from osy to gsm, multiply osy by 33.91).

As used herein the terms “sheet” and “sheet material” shall be interchangeable and in the absence of a word modifier, refer to woven materials, nonwoven webs, polymeric films, polymeric scrim-like materials, and polymeric foam sheeting.

As used herein the term "microfibers" means small diameter fibers having an average diameter not greater than about 75 microns, for example, having an average diameter of from about 0.5 microns to about 50 microns, or more particularly, microfibers may have an average diameter of from about 2 microns to about 25 microns. Another frequently used expression of fiber

diameter is denier, which is defined as grams per 9000 meters of a fiber and may be calculated as fiber diameter in microns squared, multiplied by the density in grams/cc, multiplied by 0.00707. A lower denier indicates a finer fiber and a higher denier indicates a thicker or heavier fiber. For example, the diameter of a polypropylene fiber given as 15 microns may be converted to denier by squaring, multiplying the result by 0.89 g/cc and multiplying by 0.00707. Thus, a 15 micron polypropylene fiber has a denier of about 1.42 (15^2 x 0.89 x .00707 = 1.415). Outside the United States the unit of measurement is more commonly the "tex", which is defined as the grams per kilometer of fiber. Tex may be calculated as denier/9.

As used herein the term "spunbond" refers to small diameter fibers which are formed by extruding molten thermoplastic material as filaments from a plurality of fine, usually circular capillaries of a spinneret with the diameter of the extruded filaments being rapidly reduced as by for example in U.S. Pat. No. 4,340,563 to Appel et al., and U.S. Pat. No. 3,692,618 to Dorschner et al., U.S. Pat. No. 3,802,817 to Matsuki et al., U.S. Pat. No. 3,338,992 and 3,341,394 to Kinney, U.S. Pat. No. 3,542,615 to Dobo et al., which are each incorporated by reference in their entirety herein.

As used herein the term "meltblown" means fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular die capillaries as molten threads or filaments into converging high velocity gas (e.g. air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameter, which may be to microfiber diameter. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Such a process is disclosed, in various patents and publications, including NRL Report 4364, "Manufacture of Super-Fine Organic Fibers" by B. A. Wendt, E. L. Boone and D.D. Fluharty; NRL Report 5265, " An Improved Device For The Formation of Super-Fine Thermoplastic Fibers" by K.D. Lawrence, R. T. Lukas, J. A. Young; and U.S. Patent No. 3,849,241, issued November 19, 1974, to Butin, et al.

As used herein, the term "bonded carded webs" refers to webs that are made from staple fibers which are usually purchased in bales. The

bales are placed in a fiberizing unit/picker which separates the fibers. Next, the fibers are sent through a combining or carding unit which further breaks apart and aligns the staple fibers in the machine direction so as to form a machine direction-oriented fibrous non-woven web. Once the web has been formed, it is then bonded by one or more of several bonding methods. One bonding method is powder bonding wherein a powdered adhesive is distributed throughout the web and then activated, usually by heating the web and adhesive with hot air. Another bonding method is pattern bonding wherein heated calender rollers or ultrasonic bonding equipment is used to bond the fibers together, usually in a localized bond pattern through the web and or alternatively the web may be bonded across its entire surface if so desired. When using bi-component staple fibers, through-air bonding equipment is, for many applications, especially advantageous.

As used herein the term "polymer" generally includes but is not limited to, homopolymers, copolymers, such as for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" includes all possible geometrical configurations of the molecule. These configurations include, but are not limited to isotactic, syndiotactic and random symmetries.

As used herein, the term "bond" and derivatives does not exclude intervening layers between the bonded elements that are part of the bonded structure unless the text requires a different meaning.

As used herein the term "thermal point bonding" involves passing a fabric or web of fibers to be bonded between a heated calender roll and an anvil roll. The calender roll is usually, though not always, patterned in some way so that the entire fabric is not bonded across its entire surface, and the anvil roll is usually flat. As a result, various patterns for calender rolls have been developed for functional as well as aesthetic reasons. One example of a pattern has points and is the Hansen Pennings or "H&P" pattern with about a 30% bond area with about 200 bonds/square inch as taught in U.S. Patent 3,855,046 to Hansen and Pennings, incorporated herein by reference in its entirety. The H&P pattern has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of

0.070 inches (1.778 mm) between pins, and a depth of bonding of 0.023 inches (0.584 mm). The resulting pattern has a bonded area of about 29.5%. Another typical point bonding pattern is the expanded Hansen Pennings or "EHP" bond pattern which produces a 15% bond area with a square pin having a side dimension of 0.037 inches (0.94 mm), a pin spacing of 0.097 inches (2.464 mm) and a depth of 0.039 inches (0.991 mm). Another typical point bonding pattern designated "714" has square pin bonding areas wherein each pin has a side dimension of 0.023 inches, a spacing of 0.062 inches (1.575 mm) between pins, and a depth of bonding of 0.033 inches (0.838 mm). The resulting pattern has a bonded area of about 15%. Yet another common pattern is the C-Star pattern which has a bond area of about 16.9%. The C-Star pattern has a cross-directional bar or "corduroy" design interrupted by shooting stars. Other common patterns include a diamond pattern with repeating and slightly offset diamonds with about a 16% bond area and a wire weave pattern looking as the name suggests, e.g. like a window screen pattern having a bond area in the range of from about 15% to about 21% and about 302 bonds per square inch. Typically, the percent bonding area varies from around 10% to around 30% of the area of the fabric laminate web. As is well known in the art, the spot bonding holds the laminate layers together as well as imparts integrity to each individual layer by bonding filaments and/or fibers within each layer.

As used herein, the term "ultrasonic bonding" means a process performed, for example, by passing the fabric between a sonic horn and anvil roll as illustrated in U.S. Patent 4,374,888 to Bornslaeger, incorporated by reference herein in its entirety.

As used herein, the term “adhesive bonding” means a bonding process which forms a bond by application of an adhesive. Such application of adhesive may be by various processes such as slot coating, spray coating and other topical applications. Further, such adhesive may be applied within a product component and then exposed to pressure such that contact of a second product component with the adhesive containing product component forms an adhesive bond between the two components.

As used herein the term “laminate” refers to a composite structure of two or more sheet material layers that have been adhered through a

bonding step, such as through adhesive bonding, thermal bonding, point bonding, pressure bonding, extrusion coating or ultrasonic bonding.

As used herein, the term "composite elastic material", refers to a material having at least one elastic material joined to at least on sheet material. In most embodiments such laminates will have a gatherable layer which is bonded to an elastic layer or material so that the gatherable layer may be gathered between bonding locations. As set forth herein, the composite elastic material may be stretched to the extent that the gatherable material gathered between the bond locations allows the elastic material to elongate.

As used herein, the term "continuous filaments", refers to strands of continuously formed polymeric filaments having a length to diameter ratio of at least about a thousand and usually much higher. Such filaments will typically be formed by extruding molten material through a die head having a certain type and arrangement of capillary holes therein.

As used herein, the term "elastomeric" shall be interchangeable with the term "elastic" and refers to material which, upon application of a stretching force, is stretchable in at least one direction (such as the CD direction), and which upon release of the stretching force contracts/returns to approximately its original dimension. For example, a stretched material having a stretched length which is at least 50 percent greater than its relaxed unstretched length, and which will recover to within at least 50 percent of its stretched length upon release of the stretching force. A hypothetical example would be a one (1) inch sample of a material which is stretchable to at least 1.50 inches and which, upon release of the stretching force, will recover to a length of not more than 1.25 inches. Desirably, such elastomeric material contracts or recovers up to 50 percent of the stretch length in the cross machine direction using a cycle test as described herein to determine percent set. Even more desirably, such elastomeric material recovers up to 80 percent of the stretch length in the cross machine direction using a cycle test as described. Even more desirably, such elastomeric material recovers greater than 80 percent of the stretch length in the cross machine direction using a cycle test as described. Desirably, such elastomeric sheet is stretchable and recoverable in both the MD and CD directions. For the

purposes of this application, values of load loss and other "elastomeric functionality testing" have been generally measured in the CD direction, unless otherwise noted. Unless otherwise noted, such test values have been measured at the 50 percent elongation point of a 70 percent total elongation cycle.

As used herein, the term "elastomer" shall refer to a polymer which is elastomeric.

As used herein, the term "thermoplastic" shall refer to a polymer which is capable of being melt processed.

As used herein, the term "inelastic" or "nonelastic" refers to any material which does not fall within the definition of "elastic" above.

As used herein the terms "recover", "recovery" and "recovered" shall be used interchangeably and shall refer to a contraction (retraction) of a stretched material upon termination of a stretching force following stretching of the material by application of the stretching force. For example, if a material having a relaxed, unstretched length of 1 inch (2.5 cm) is elongated fifty percent by stretching to a length of 1.5 inches (3.75 cm), the material would be elongated 50 percent and would have a stretched length that is 150 percent of its relaxed length or stretched 1.5X (times). If this exemplary stretched material contracted, that is recovered to a length of 1.1 inches (2.75 cm) after release of the stretching force, the material would have recovered 80 percent of its 0.5 inch (1.25 cm) elongation. Percent recovery may be expressed as [(maximum stretch length-final sample length)/(maximum stretch length – initial sample length)] x 100.

As used herein the term "extensible" means elongatable in at least one direction, but not necessarily recoverable.

As used herein the term "percent stretch" refers to the ratio determined by measuring the increase in the stretched dimension and dividing that value by the original dimension. i.e. (increase in stretched dimension/original dimension) x 100.

As used herein the term "stretch-to-stop" refers to a ratio determined from the difference between the unextended dimension of a composite elastic material and the maximum extended dimension of a composite elastic material upon application of a specified tensioning force and dividing that

difference by the unextended dimension of the composite elastic material. If the stretch-to-stop is expressed in percent, this ratio is multiplied by 100. For example, a composite elastic material having an unextended length of 5 inches and maximum extended length of 10 inches upon applying a force of 2000 grams has a stretch-to-stop (at 2000 grams) of 100 percent. Stretch-to-stop may also be referred to as "maximum non-destructive elongation." Unless specified otherwise, stretch-to-stop values are reported herein at a load of 2000 grams.

Test Method Procedures

Stretch-to-Stop Test:

In the elongation or stretch-to-stop test, a 3 inch by 7 inch (7.62 cm by 17.78 cm) sample, with the larger dimension being the machine direction, is placed in the jaws of a Sintech System 2 tensile test frame available from Sintech Corp. of Cary, N.C. using a gap of 4 inches between the jaws. The sample is pulled to a stop load of 2000 grams with a crosshead speed of about 20 inches/min (500 mm/min). The percent elongation at the 2000 gram load is recorded as the stretch-to-stop of the specimen. The test is repeated for a total of ten specimens. The average stretch-to-stop of the ten specimens is recorded as the stretch-to-stop for the material. The test is conducted at ambient conditions.

Detailed Description of the Invention

Composite elastic laminates are known in the art as are the methods of their manufacture. These laminates are useful in absorbent products due to the benefits that they provide to the products, including flexibility, conformability and overall fit. To ensure these properties it is useful to be able to control the stretch and impart levels of stretch where it is most effective.

Another important property, known especially by those having skill in elastics, is a property known as inherent latency. As used herein, the term "inherent latency" means the elasticity of a material, which is dormant until

the material has been subjected to an activation process, for example, to elevated temperatures such as the body temperature of the wearer, for instance. Once activated the material has retraction properties. In some instances, it is desired to maximize the level of inherent latency in particular areas of the product, for example, to improve fit at the waist. In other instances, it is desired to minimize the amount of inherent latency if not eliminate it all together. It may also be helpful to control the amount of inherent latency in various zones of the same material.

This control of the stretch and inherent latency can be accomplished by the present invention. Design of the bond pattern on the nonwoven facings, the bonding used in laminating the elastic laminate and bonding added to the finished elastic laminate can all work together to control the stretch and inherent latency.

Designing the bond pattern on the facings of the elastic laminate to maximize stretch or retraction should maximize the stretch or retraction beyond what can be achieved with only machine settings and laminating nip type of the elastomeric laminate process. This incremental additional stretch from the use of directionally oriented facing or laminate bond pattern may allow for the ability to use less material to achieve the same material extensibility or achieve greater extensibility in a given material. This allows for greater cost savings and process efficiency opportunities.

One of the parameters used to control the properties in an elastomeric composite material is in the design and orientation of the bond pattern present on the facings of the laminate. In the present invention the facing layer is generally a nonwoven web. This nonwoven web may be, for example, a spunbond web, a meltblown web, a bonded carded web, or a combination thereof. Such nonwoven webs are stabilized with a bonding pattern applied to the fibers of the nonwoven web. In the present invention, the bond pattern is configured in such a way to orient the bonding primarily in a chosen direction.

Such a bond pattern can be comprised of plurality of discrete bond elements **11** all oriented in a single direction **X**, as shown in Fig. 1. Alternatively, the bond pattern can be a plurality of continuous bond

elements **21** which have more of the bond area oriented in one direction **X**, as shown in Fig. 2. In both Fig. 1 and Fig. 2, the total level of bonding is greater in the direction indicated as **X** and is lesser in the direction indicated as **Y**.

The bond elements **11**, **21** can be further characterized in terms of the dimension of the bonds in relation to the directions of the nonwoven material. Fig. 1A shows a single bond element **11** of the nonwoven bond pattern of Fig. 1. The bond element **11** has a first bond dimension **H** lying along a first direction (marked as **X** in Fig. 1A) which is greater than the second bond dimension **B** lying along a second direction (marked as **Y** in Fig. 1A). The first and second bond dimensions for the bond element **11** can also be represented as vectors along the corresponding **X** and **Y** directions, as shown in Fig. 1B.

Defining the continuous bond elements **21** of Fig. 2 is slightly more complex than the bond elements **11** of Fig. 1, but the same concepts apply. A portion of the continuous bond element **21** of Fig. 2 is illustrated in Fig. 2A. The portion of the continuous bond element **21** can be broken into the component parts of the bond as they relate to the first and second directions (indicated as the **X** and **Y** directions, respectively, in Fig. 2A). As shown in Fig. 2A a single repeat of the continuous bond element **21** contains a segment that extends upward along the **X** direction for a first bond dimension **H** and along the **Y** direction for a second bond dimension of **B**. The repeat also contains an adjacent segment that extends downward along the **X** direction for another first bond dimension **H** and along the **Y** direction for another second bond dimension **B**. Again, the segments of the bond can be represented by the vectors as shown in Fig. 2B. The resultant vectors of Fig. 2B would represent the actual bond segment that can then be resolved into vectors along the **X** and **Y** directions which represent the first and second bond dimensions respectively. As the invention relates to the total amount of bonding oriented along either the **X** or the **Y** directions, only the absolute values of the first and second bond dimension are considered. In other words, the direction of the representative vectors in the **X** and **Y** directions is unimportant; only the magnitude of that vector in the **X**

or **Y** directions is important. Therefore, the total bond dimensions for the single repeat of the continuous bond element **21** of Fig. 2 can be represented by the vectors shown in Fig. 2C. As can be seen in Fig. 2C, the total first bond dimension **2H** along the **X** direction is much greater than the total second bond dimension **2B** along the **Y** direction for a single repeat of the continuous bond element **21**. Even though the wave pattern of the continuous bond element **21** repeats along the **Y** direction, it can be seen that the bonding of the pattern is oriented in the **X** direction.

As can be seen in Fig. 1 and Fig. 2, the plurality of bond elements **11**, **21** make up a bond pattern. The overall bond pattern orientation can be defined by the first and second dimensions of the bond elements that make up that pattern. The nonwoven bond pattern dimension ratio is defined here as the sum of the first bond dimensions of the bond elements in a unit area over the sum of the second bond dimensions of the bond elements in the same unit area. The unit area of measurement, for example, is a three inch by three inch square area or minimally is the square area required to encompass a full repetition of a bond pattern. For the patterns shown in Fig. 1 and in Fig.2, the first bond dimensions **H** are greater than the second bond dimensions **B** for the individual bond elements **11**, **21**. Therefore, the sum of the first bond dimensions over the sum of the second bond dimensions for a unit area (i.e., the nonwoven bond pattern dimension ratio), for either the pattern of Fig. 1 or Fig. 2, will have a value greater than one. A value for the nonwoven bond pattern dimension ratio greater than one indicates that the bond pattern as a whole has more of the bonding oriented in the first direction than in the second direction (as shown in Fig. 1 and Fig. 2). Conversely, a nonwoven bond pattern dimension ratio with a value less than one would indicate that the bond pattern had more bonding oriented in the second direction than in the first direction.

For a nonwoven bond pattern that is comprised of non-identical bond elements, the same characterization of bonding orientation can be made. The first and second bond dimensions would have to be determined for each individual bond element. The first bond dimension would be the longest dimension of each individual bond, relative to the first direction.

Likewise, the second bond dimension would be the longest dimension of each individual bond, relative to the second direction. As discussed above, the nonwoven bond pattern dimension ratio is the sum of the first bond dimensions of the individual bond elements in a unit area over the sum of the second bond dimensions of the individual bond elements in the same unit area. The unit area of measurement, for example, is a three inch by three inch square area or minimally is the square area required to encompass a full repetition of a bond pattern.

Bonded areas are more rigid than unbonded areas. Thus a material that is bonded with such a directionally oriented bond pattern will be more rigid in one direction, namely the direction the bonds are aligned along, than in the second direction perpendicular to the bond alignment. This ultimately should affect the properties of the finished laminate into which these facings are incorporated. When the bond pattern is oriented in such a way to place the direction with a higher level of bonding parallel to the stretch axis of the laminate, the level of stretch along the stretch axis will be decreased. The higher the degree of bonding aligned parallel to the stretch axis of the laminate will minimize the stretch of the laminate. The same effect should occur regarding the ability of the material to retract upon activation.

In terms of the nonwoven bond pattern dimension ratio, if the direction of stretch is the first direction, to minimize the stretch of the laminate one would desire a nonwoven bond pattern dimension ratio of greater than one (i.e., more bonding in the first direction than in the second direction). To affect a greater reduction in stretch, one could have a nonwoven bond pattern dimension ratio greater than three. To affect an even greater reduction in stretch, one could have a nonwoven bond pattern dimension ratio greater than five.

Conversely, to maximize the level of available stretch or maximize the amount of retraction available, the bonds could be oriented on the facings such that in the final elastic laminate the direction of higher bonding on the facings is aligned perpendicular to the stretch axis of the laminate.

Again, in terms of the nonwoven bond pattern dimension ratio, if the direction of stretch is the first direction, to maximize the stretch of the laminate one would desire a nonwoven bond pattern dimension ratio of less

than one (i.e., more bonding in the second direction than in the first direction). A greater effect could be realized with a nonwoven bond pattern dimension ratio of less than 0.33. An even greater effect could be realized with a nonwoven bond pattern dimension ratio of less than 0.20.

Alternatively, it may be desired that the same material have zones, or regions, of high stretch or high retraction and other zones with low stretch or low retraction. This type of an elastomeric laminate may be made with facings with a bond pattern like the one depicted in Fig. 3. As shown in Fig. 3, it is also possible that the facings can have zones of bond pattern oriented in the first direction **X** and adjoining zones where the bond pattern is oriented in the second direction **Y**. If a laminate were made with a facings bond pattern as in Fig. 3 and the direction marked as **Y** was the stretch axis, the zone indicated as **330** would have a higher stretch, or retraction, than the adjoining zone indicated as **333**.

The elastomeric layer of the present invention may comprise elastic continuous filaments that are substantially parallel to each other. While continuous filaments are the preferred embodiment, it is also possible that an elastomeric film could be used, with similar expected results. The continuous elastic filaments can be produced by processes known in the art and described in U.S. Patent No. 5,385,775 to Wright and U.S. Patent Application Publication 2002-0104608 to Welch et al., both of which are incorporated by reference in their entirety. Both of the references teach laminates comprising continuous elastic filament which are extruded, cooled and stretched and bonded to a gatherable nonwoven layer in a laminating nip.

Fig. 5 schematically illustrates the process used to produce composite elastic materials. The continuous elastic filament web **130** is stretched due to a speed differential between the pinch rollers **132** and **134** and the bonder rollers **36** and **38**. Gatherable nonwoven facings layers **24** and **28** are joined to the elastic filament web **130** as they pass through the bonder roller arrangement **34** to form the composite elastic material **40**. The

composite elastic material **40** immediately relaxes upon release of the tensioning force whereby the first gatherable layer **24** and the second gatherable layer **28** are gathered in the composite elastic material **40**. The composite elastic material **40** is then wound up on a winder roll **42**.

It is desirable that such a composite elastic material be wound up at a very loose tension to maintain stretchability of the material. This is done by running the winder roll **42** at a speed slower than the bonder roll arrangement **34**. However, the winder roll **42** must maintain a certain speed to prevent the material for piling up between the winder roll **42** and the bonder roll arrangement **34**. This balance is related to how fast and how much the composite elastic material relaxes after the release of tensioning force after the bonder roll arrangement **34**. The greater the elastic material can relax prior to being wound on to the roll, the greater the stretch the material will have available when later taken off the roll for use.

As discussed above, in the production of an elastic laminate the facing layers **24,28** are joined to the elastomeric layer **130** in the bonder roll arrangement **34**. This bonder roll arrangement **34** is made up of a pair of rollers **36**, **38** that comprise a laminating nip therebetween. Such lamination can be accomplished by thermal point bonding which uses a patterned roll in pair with an anvil roll to bond the elastomeric to the facings layers. The point bonds may have the tendency to damage the elastomeric filaments which can affect the properties of the elastic laminate in the point bonded areas of the laminate material. Because of this damaging effect, point bonding would not be desirable for elastic laminates in which stretch or retraction is to be maximized. However, point bonding may be advantageous for materials, or more particularly zones within a material, where the stretch or retraction is to be minimized.

To eliminate the issue of point bonds that damage the elastic filaments upon lamination, a pair of smooth calender rollers could be used for a laminating nip, as described in PCT International Publication Number WO 98/29251 to Thomas et al, which is incorporated herein in its entirety by reference. Alternatively, a smooth calender roller could be used in conjunction with a point un-bonded calender roller (shown in Fig. 5 as **38**)

as described in U.S. Patent No. 6,387,471 B1 to Taylor et al, which is also incorporated herein by reference in its entirety. Both the smooth rollers and the bond un-bonded rollers eliminate the addition of bonds that can damage the filaments. The point un-bonded roller has the added advantage of leaving portions of the elastic laminate un-bonded making available an even greater ability to stretch. The smooth roller has the added advantage over the point un-bonded roller in that it may impart a higher degree of inherent latency and thus a higher available retraction upon activation.

Additional control of stretch and/or retraction can be gained by adding a laminate bond pattern to the finished composite elastic laminate. Fig. 4 illustrates such a laminate bond pattern made of a plurality of laminate bond elements **41** on the composite elastic laminate. The laminate bond elements may be made by various methods known in the art including ultrasonic bonding and thermal bonding. Such laminate bonding can be added as a final step within the production of the laminate, in the conversion of the material into a finished product or to the material within the ultimate product.

The dimensions of the laminate bond elements and orientation of the laminate bond pattern can be characterized in the same way that the nonwoven bond elements and nonwoven bond pattern were characterized above. The nonwoven bond element will have a first dimension along the first direction, indicated as **X** in Fig. 4, and will have a second dimension along the second direction, indicated as **Y** in Fig. 4. For the laminate bond elements **41** shown in Fig. 4, it can be seen that the first dimension is less than the second dimension.

The laminate bond pattern is also characterized by the laminate bond pattern dimension ratio which is defined here as the sum of the first dimensions of the laminate bond elements for a unit area over the sum of the second dimensions of the laminate bond elements for the same unit area. The unit area of measurement, for example, is a three inch by three inch square area or minimally is the square area required to encompass a full repetition of a bond pattern. For the laminate bond pattern shown in Fig. 4, the first dimensions are less than the second bond dimensions for the

individual laminate bond elements **41**. Therefore, for the pattern of Fig. 4, the sum of the first dimensions over the sum of the second dimensions for a unit area (i.e., the laminate bond pattern dimension ratio) will have a value of less than one. A value for the laminate bond pattern dimension ratio less than one indicates that the laminate bond pattern as a whole has more of the bonding oriented in the second direction than in the first direction (as shown in Fig. 4). A greater effect could be realized with a laminate bond pattern with a laminate bond pattern dimension ratio of less than 0.33. An even greater effect could be realized with a laminate bond pattern dimension ratio of less than 0.20.

Conversely, a laminate bond pattern dimension ratio with a value greater than one indicates that the laminate bond pattern as a whole has more of the bonding oriented in the first direction than in the second direction. A greater effect could be realized with a laminate bond pattern dimension ratio of greater than three. An even greater effect could be realized with a laminate bond pattern dimension ratio of greater than five.

This laminate bonding can impart additional control to stretch and retraction in a similar way such control was added by the bond pattern of the facings themselves. Laminate bonds that are added parallel to the stretch axis will have a greater effect on decreasing the stretch, or retraction, available than laminate bonds that are made perpendicular to the stretch axis.

One could easily impart a zone of low stretch to an otherwise high stretch material (e.g. where facings have pattern oriented with less bond area in the direction of stretch) by applying laminate bonds that are oriented parallel to the stretch axis of the elastic laminate. This is illustrated in Fig. 4 where the stretch axis is the direction marked as **Y**. As shown in Fig. 4, the bonds **11** present on the nonwoven layer of the composite elastic material **15** are aligned perpendicular to the direction of stretch **Y**. The laminate bonds **41** are made on the composite elastic material **15** such that the laminate bonds **41**are aligned parallel to the direction of stretch **Y**. Thus the composite elastic material **15** will have a zone of lower stretch **444** (or retraction) where the laminate bonds are present and parallel to the

direction of stretch **Y** than is present in adjacent stretch zones **440** where no such laminate bonds are present.

Often such composite elastic materials are attached to other materials in the manufacture of personal care products. These attachments are primarily made with such laminate bonds. For the composite elastic material to provide the personal care product with the greatest amount of stretch, or retraction, the laminate bonds used to attach the composite elastic material should run perpendicular to the stretch axis of the composite elastic material. In the same way, if zones of reduced stretch are desired of the composite elastic material incorporated into a personal care product, the composite elastic material can be attached to the personal care product with laminate bonds as shown in Fig. 4, and as discussed above.

One of the steps contemplated by this method of control is the addition of a legible label to a high retraction material. One problem with embossing a label on a high retraction material is designing the label such that when retracted the label is still legible. Elongating the embossing pattern is not desirable due to the normal variable nature of production materials and the variable nature of activation within converting processes. Alternatively, one can design an embossing pattern that incorporates a high degree of bonding oriented in the direction of the stretch axis. This would mean using fatter and wider characters, or letters, oriented in the appropriate direction, rather than tall and skinny characters or letters.

In one desirable embodiment of the present invention the composite elastic material would be a continuous filament elastic laminate in which the retraction is maximized. The facing layers are polypropylene spunbond webs that utilize the bond pattern as shown in Fig. 1. The bonds of the facings layer would be oriented such that the dimension with the greater total bonding would lie in the cross-machine dimension of spunbond web, as indicated as direction **X** in Fig. 1. The elastomeric layer would be comprised of substantially parallel elastomeric filaments bonded in part to a web of elastomeric meltblown fibers. The spunbond facings are oriented in relationship to and subsequently laminated to the elastomeric filaments in such a way that the dimension with the greater total bonding (direction **X** in

Fig. 1) is perpendicular to the substantially parallel elastomeric filaments (direction **Y** in Fig. 1). The spunbond facing layers are laminated to the elastomeric web using a pair of smooth calender rollers, which make up the laminating nip. When converted into a product, the material is attached to the product using only a minimum of bonds, those bonds being perpendicular (direction **X** in Fig. 1) to the direction the material is to retract (direction **Y** in Fig. 1).

In another embodiment of the present invention, the composite elastic material would be a continuous filament elastic in which the stretch has been maximized. The facing layers are polypropylene spunbond webs that utilize the bond pattern as shown in Fig. 1. The bonds of the facings layer would be oriented such that the dimension with the greater total bonding would lie in the cross-machine dimension of spunbond web, as indicated as direction **X** in Fig. 1. The elastic layer is comprised of substantially parallel elastomeric filaments. The elastic filaments and the subsequent laminate is produced by the method discussed in PCT International Publication Number WO 01/87589 A2 to Welch et al. In such a method, an adhesive is used to bond the elastic filaments to the facing layers and the adhesive pattern contacts the elastic filament at a substantially perpendicular angle. The spunbond facings are oriented in relationship to and subsequently laminated to the elastomeric filaments in such a way that the dimension with the greater total bonding (direction **X** in Fig. 1) is perpendicular to the substantially parallel elastomeric filaments (direction **Y** in Fig. 1). The spunbond facing layers are laminated to the elastomeric web using a laminating nip comprising a smooth anvil roller and a point un-bonded calender roller. When converted into a product, the material is attached to the product using only a minimum of bonds, preferably only at the terminal ends of the area to be extended, and those bonds being perpendicular (direction **X** in Fig. 1) to the direction the material is to retract (direction **Y** in Fig. 1).

Another embodiment of the present invention would be a composite elastic material that has zones of high stretch and zones of low stretch. The

facing layers are polypropylene spunbond webs that utilize the bond pattern as shown in Fig. 3. The elastomeric layer would be comprised of substantially parallel elastomeric filaments bonded in part to a web of elastomeric meltblown fibers.

The spunbond facings are oriented in relationship to and subsequently laminated to the elastomeric filaments in such a way that the zones with the greater total bonding perpendicular to the substantially parallel elastomeric filaments (zone **3** of Fig. 3) will be high stretch zones. The zones where the greater total bond area is parallel to the elastomeric filaments (zone **4** of Fig. 3) will be low stretch zones.

The spunbond facing layers are laminated to the elastomeric web using a laminating nip comprising a smooth anvil roller and a point un-bonded calender roller. After the material is laminated, thermal bonds are added to the composite elastomeric laminate in areas of laminate having facings with a pattern similar to zone **4** of Fig. 3. These additional thermal bonds would also be an elongated element in which the longer dimension of the bond extends parallel to the elastic filaments of the elastomeric laminate.

<u>Examples</u>

The invention will be illustrated by examples which are representative only and not intended to limit the invention which is defined by the appended claims and equivalents. Modifications and alternatives will be apparent to those skilled in the art and are intended to be embraced by the invention as claimed.

Example 1

In Example 1, a composite elastic material was produced. The elastomeric layer of the composite material was made of continuous elastomeric filaments and elastomeric meltblown fibers. The elastic continuous filaments were made of Kraton® G-2760 elastomeric (polystyrene/ poly(ethylene-propylene) / polystyrene / poly(ethylene-propylene)) block copolymer, The elastomeric meltblown fiber was meltblown onto the continuous filaments to make an elastic fibrous web having a basis weight of 16 gsm, where the basis weight ratio of continuous filaments to

meltblown fibers is 90:10. The elastomeric meltblown fibers were also made of Kraton® G-2760 elastomeric block copolymer.

Additionally, a gatherable layer of 0.4 osy (13.6 gsm) white spunbond nonwoven web made of polypropylene available from Kimberly-Clark was attached to each side of the elastic fibrous web. The spunbond nonwoven webs were made generally as described in US Published Patent Application US 2002-0117770 to Haynes et al., incorporated herein by reference in its entirety. The nonwoven webs were bonded using a wire weave bond pattern, looking as the name suggests, e.g. like a window screen and having a bond area in the range of from about 15% to about 20% and about 302 bonds per square inch. A representation of the wire weave pattern is illustrated in Fig. 6.

The layers were laminated together with the use of a laminating nip made by a pair of smooth calender rollers. The elastomeric layer was extended 5.88x in the machine direction before it entered into the laminating nip. This draw ratio of 5.88 was imparted to the elastomeric layer by having the calender rollers at a higher speed than the pinch rollers. The material was then wound up with a winder ratio of 0.625 (i.e., the winder ran at a speed that is 62.5% of that of the calender rollers).

The resultant composite elastic material had a basis weight of 2.098 osy (71.1gsm), measured after a reference sample length of the material cut from the finished roll was allowed to relax to 60% of its referenced length. The elastic material of Example 1 had a stretch-to-stop of 232%.

Example 2

In an example contemplated to fall within the scope of the invention, the composite elastic material of Example 2, may be made from the same elastomeric materials and by the same process as Example 1. The gatherable nonwoven of Example 2 could also be 0.4 osy (13.6 gsm) white spunbond nonwoven web made of polypropylene available from Kimberly-Clark. However, the nonwoven web could be the bond pattern as shown in Fig. 1, rather than the wire weave pattern of Example 1. The bond pattern of Fig. 1 would be oriented such that the direction marked as **Y** in Fig. 1 would

be the machine direction, which is also the direction of elastic filaments (i.e., the direction of stretch).

The bond pattern of Fig. 1 is similar to that of the wire weave bond pattern as shown in Fig. 6 except that bond elements of Fig. 6 which lie parallel to the direction of stretch are removed. The resultant composite elastic material of Example 2 should have a higher stretch-to-stop value than that of Example 1.

While the invention has been described in detail with reference to specific embodiments thereof, it should be understood that many modifications, additions and deletions can be made thereto without departure from the spirit and scope of the invention as set forth in the following claims